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"The Association for Fixed Wireless Broadband Access"

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November 1, 2000

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

VIA HAND DELIVERY
Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
TW-A325
Washington, D.C. 20554

Re: RM-9920

Dear Ms. Salas:

Attached for inclusion in the record for the above-captioned petition for rulemaking filed by the Cellular Telecommunications Industry Association are two copies of a preliminary study that has been prepared by George Harter, Director of Engineering at MSI, for the Sprint Broadband Wireless Group, WorldCom Broadband Solutions, Nucentrix Broadband Networks and The Wireless Communications Association International, Inc. This study is being submitted in preliminary fashion in order to accommodate the expedited schedule established by the National Telecommunications and Information Administration for the release of the Commission's initial report on the use of the 2500-2690 MHz band. Nonetheless, this study establishes the inability of terrestrial third generation mobile services to share the same frequencies as are used for MDS/ITFS operations.

Should you have any questions concerning this matter, please contact me directly.

Very truly yours,

Andrew Kreig

Andrew Kreig
President

Cc: Julius Knapp
Fred Thomas
Brad Lerner

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Feasibility Study on Spectrum Sharing between Fixed Terrestrial Wireless Services and proposed Third Generation Mobile Services in the 2500-2690 MHz Bands

Abstract

The frequency bands from 1710-1885 MHz and 2500-2690 MHz have been identified at WRC-2000 as spectrum for consideration in the implementation of proposed third generation ("3G") mobile services internationally. However, it was recognized that full utilization of any identified band might not be possible because of domestic uses in certain countries. In the US, the bands 2150-2162 and 2500-2690 MHz are utilized extensively for fixed wireless services commonly know as Multichannel Multipoint Distribution Services ("MMDS") and Instructional Television Fixed Services ("ITFS"). These point-to-multipoint services have been in existence for over 40 years and have numerous transmission and reception points throughout the country. Historically utilized for video distribution, these services have undergone important regulatory changes over the past several years to allow the industry to evolve into a bi-directional digital high speed Internet access service. The first regulatory filing period has now concluded and implementation of these broadband data services on a wide scale basis has begun.

Co-frequency utilization by existing and planned MMDS/ITFS services and proposed 3G services will not be possible because of unavoidable and unacceptable interference between the two services. Interference from 3G services into MMDS/ITFS will be severe because of (1) the sensitivity of the MMDS/ITFS receivers (both hub and CPE) based on the need to utilize higher order modulation techniques, (2) the commercial necessity of utilizing economical receive antennas and the inability to discriminate the mobile 3G services for interference isolation, (3) the already compromised interference environment created by existing levels of co-channel interference between neighboring markets and (4) the need for high degrees of frequency reuse within urban markets to meet the expected capacity demands. Likewise, interference from MMDS/ITFS services into 3G services will be severe because of (1) the use of omnidirectional mobile receive antennas with no ability to discriminate, (2) the high power levels of the fixed services at the hub broadcast over a wide or omnidirectional area, (3) the power levels of the CPE return path transmissions and (4) the high probability that 3G receivers will be in close proximity to either MMDS/ITFS hub or CPE sites.

MMDS/ITFS System Operation

The architectures for MMDS/ITFS systems vary based on the service offering, the population of the market and the terrain characteristics of the market

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area. Currently there are four basic service offerings: analog television, digital television, unidirectional digital data and bi-directional digital data. The architecture that will be utilized in many second and third tier markets to deliver all of these services is a single cell or "super cell" configuration. This architecture utilizes a single transmit site located on a high building or tower to cover a large area (up to 35 miles in radius.) This architecture may utilize an omnidirectional or broad beamwidth cardioid antenna with power levels as high as the FCC rules will allow. In certain markets where terrain or foliage is severe, repeaters may be used to fill in areas of poor coverage. These repeaters rebroadcast all channels on the same frequencies as they are received. Therefore, self-interference can only be controlled by isolation between service areas created by terrain or other obstructions.

Cellular architectures are being developed primarily for larger markets where the expected demand for broadband data can support the increased costs. This architecture utilizes existing buildings or towers located in close proximity to potential customer locations with the minimum height and power necessary to achieve the path reliability throughout the desired coverage area. Interference is controlled by careful frequency planning utilizing polarization, sector geometry and receive antenna isolation.

Analog Television

A majority of the analog television MMDS/ITFS implementations in the US utilize an architecture where a single high power transmitter is located on a tall transmit site in or near a populated area. In urban environments, this site is usually a tall building or tower in or near the center of population. The transmit antenna pattern will typically be omnidirectional or a wide cardioid. In more rural markets the transmit site may be removed from the population center in order to take advantage of high terrain feature or an existing tower and a more directional cardioid antenna would be utilized to concentrate coverage in the desired area. The maximum EIRP allowed by the FCC is 2000 watts peak analog power when an omnidirectional transmit antenna is utilized. Slightly higher power levels may be allowed in certain cases when cardioid antennas are utilized. Typical EIRP's are in the 100 –1000 watt range. Either horizontal or vertical polarization is allowed.

Receive sites utilize directional antennas of various sizes and gains dependent upon distance from the transmit site and the quality of the propagation path to the transmit site. These antennas range in gain from 12 to 27 dBi and vary in size from approximately 0.2 – 1.2 meters in diameter. A copy of the antenna patterns for several representative antennas is attached as Appendix 1. The height of these antennas must be sufficient to achieve an unobstructed or very nearly unobstructed propagation path to the transmit site. Because of size and cost, the smaller antennas are practical for deployment on a broad scale at single family homes while the large antennas tend to be utilized at multi-dwelling units or businesses.

Analog television signals require a very high carrier-to-noise ratio ("C/N") at the receive site in order to produce a high quality video signal. Degradations in received signal strength due to obstructed paths or interference will very quickly manifest themselves as degraded picture quality. Current FCC rules require the carrier-to-interference ratio ("C/I") for incumbent stations to be maintained at 45 dB for co-channel stations operating in neighboring markets. This level of protection must be maintained at all unobstructed areas in a protected service area defined as a 35 mile radius circle around the desired transmit site. This level of co-channel interference protection will result in a subjective picture quality of grade 3 based on the ITU/R Recommendation 500 rating scale. This figure of merit categorizes the impairment caused by the interference as "slightly annoying."

Digital Television

Digital television systems utilize the same supercell architecture as analog television systems with similar technical configurations for the transmit and receive site equipment. Transmit power limits remain the same but the EIRP is now referenced to average digital power. The major difference is in the practical interference protection requirement. Although the current FCC rules require the same 45 dB co-channel protection as analog systems, digital systems can tolerate more interference. The modulation technique employed in digital TV MMDS/ITFS systems is 64-QAM with forward error correction included. This modulation allows receivers to tolerate lower C/I than the 45 dB FCC analog television requirement.

Data Transmissions

Data systems will utilize one of two different architectures depending on the location of the market, the number of potential subscribers, and the desired service offerings. In second and third tier markets where the number of potential subscribers and the desired service offering can only support a single transmit site, a supercell architecture is employed. The technical configurations for the downstream transmissions are the same as an analog or digital television system as described above with the addition of sectorization at the antenna to improve frequency reuse and capacity. These systems currently utilize various modulation techniques including QPSK, 64-QAM, VOFDM and TDMA or CDMA multiplexing techniques.

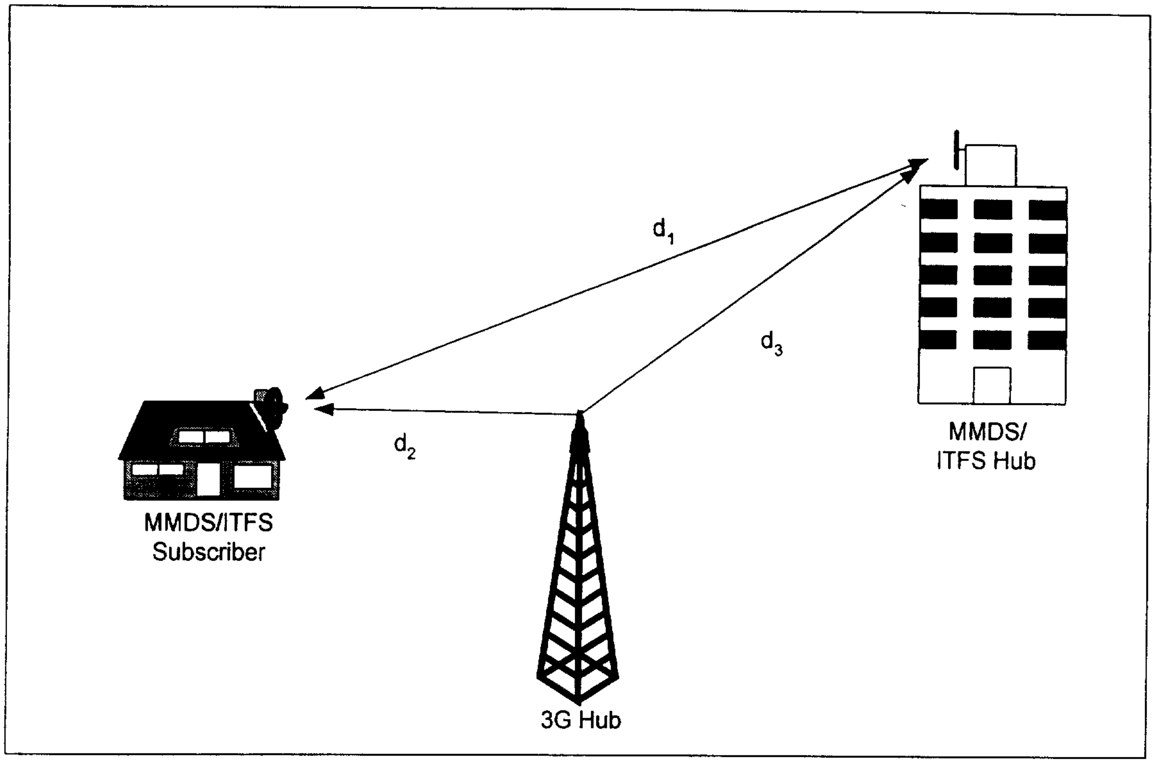
Upstream transmissions are accomplished at a subscriber site through a transverter, typically utilizing the same antenna for transmission as reception. These antennas have the same gain range as described previously of 12 to 27 dBi. Many of the transverters and antennas are built as integrated units. The upstream receive antennas for integrated units will have typical gains in the 10 to 24 dBi range.

In larger markets where the potential subscriber base can support multiple cell sites, frequency reuse is necessary to meet the capacity demands. In order to implement an aggressive frequency reuse plan, a cellular architecture must be employed. The technical characteristics will be similar to those discussed previously with downstream and upstream power levels in the range of 1 – 100 watts EIRP.

Interference Into MMDS/ITFS Systems

The interference potential from 3G mobile units to the fixed receive sites of an MMDS/ITFS system operating in the same frequency band is real but difficult to predict. These mobile units will be deployed in mass with expected high densities of transmitters. A simulation methodology has to be created in order to estimate the amount of interference power a system could be generating in the area of MMDS/ITFS receive sites. The development of this simulation methodology is beyond the scope of this paper.

However, predicting the potential for interference from 3G hubs or base stations to MMDS/ITFS receivers is a more manageable task. This potential for interference can best be described by first calculating the predicted level of interference between typical 3G and MMDS/ITFS system configurations and then determining a minimum required separation distance between systems to reduce the predicted interference to manageable levels. MMDS/ITFS receive sites can exist at subscriber locations for downstream transmissions or at hub locations for upstream transmissions. If interference is predicted to be small, then the minimum separation distance will be small and systems can coexist. However, if the predicted interference is severe and the separation distance is predicted to be large, the potential for widespread interference is large and coexistence becomes impossible.



The above diagram depicts the potential for interference from a 3G hub to MMDS/ITFS receive sites. It is assumed from a practical standpoint that 3G hubs will be distributed around a market area in a way that is similar to the distribution of current PCS and cellular towers, resulting in 3G hubs being located in close proximity (i.e., on the order of 500 - 1000 feet) to many homes and businesses that are potential subscribers to services offered by MMDS/ITFS systems. As shown below, however, the calculated minimum tolerable separation distances for coexistence between 3G hubs and MMDS/ITFS receive locations is on the order of tens of miles which would result in significant potential for harmful interference to both analog and digital MMDS/ITFS services.

Analog Television Receive Sites

Assuming the maximum acceptable level of co-channel interference from a 3G mobile unit or hub to a MMDS/ITFS analog television receive site is 45 dB (C/I), the expected degree of interference to typical system configurations from one or more 3G hubs can be calculated. This level of interference protection is currently required by the Commission in the rules covering MMDS and ITFS operation.

Assume for the first scenario a typical MMDS/ITFS transmit site configuration with an omnidirectional transmit antenna operating with an EIRP of 100 watts. The transmit antenna height will be placed at 90 meters AGL. The MMDS/ITFS receive site will use a 12 dBi antenna and will be located 1 to 35 miles from the transmit site.

The 3G hub is assumed to be operating with 100 watts of average EIRP spread across a 4.5 MHz bandwidth. The 3G hub is also assumed to be broadcasting omnidirectional. This assumption may not be reasonable on a single frequency, however, if all of the frequencies used by the various 3G sectors are co-channel with the MMDS/ITFS frequencies then the study will represent a composite of all the potential for interference across the band. The 3G hub is assumed to be located approximately 8 miles away from the MMDS/ITFS hub. This distance is very conservative and presents a scenario where 3G services have the best chance of not creating interference to MMDS/ITFS services.

The results of the study are shown below in Figure 1. The various colored regions represent different levels of predicted interference. An area that meets or exceeds the 45 dB requirement appears on the figure in green. As the study shows, a majority of the 35 mile service area would receive harmful interference from a single 3G hub. This area of interference represents approximately 60% of the total MMDS/ITFS potential service area. In fact, a majority of the interference area experiences interference levels of 20 dB or greater.

3G Hub Interference to MMDS/ITFS

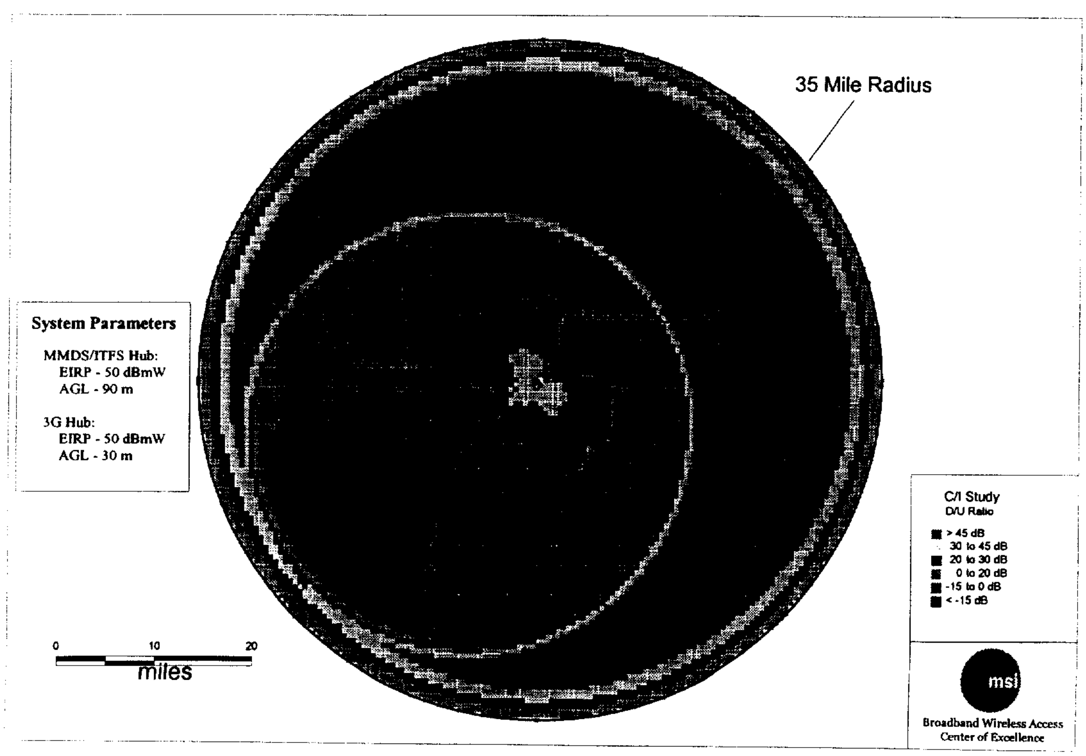


Figure 1~~1~~ - Interference from a single 3G hub to an MMDS/ITFS service area.

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A minimum separation distance between a 3G transmitter and an MMDS/ITFS receive site can be calculated using the same assumptions regarding system operation specified above. Antenna discrimination will not be considered as there will certainly be locations oriented towards both the 3G and MMDS hub. The table below shows the required separation distances in order to reduce the interference shown above to acceptable levels. As one can see, the required separation distances are calculated to be in miles, not feet. In fact, all of the distances calculated are well beyond the radio horizon for normal 4/3 earth curvature. Therefore, the actual separations will be a function of the radio horizon and the excess path attenuation generated by terrain and obstruction blockage. Therefore, coexistence between 3G services and analog television services is impossible for this scenario.

Distance between MMDS Tx and Rx (miles)	Path Loss (dB)	MMDS Rx LVL (dBm)	Required 3G Rx Lvl for 45 dB C/I (dBm)	Discrimination (dB)	Required Separation (miles)
1	104.9	-54.9	-99.9	0	177.8 **
2	110.9	-60.9206	-105.921	0	355.7 **
4	116.9	-66.9412	-111.941	0	711.3 **
8	123.0	-72.9618	-117.962	0	1422.6 **
16	129.0	-78.9824	-123.982	0	2845.2 **
32	135.0	-85.003	-130.003	0	5690.5 **

** These distances are beyond the radio horizon and will therefore be limited by the radio horizon.

Table ~~1~~1. Required Separation Distance between 3G Base Station and MMDS/ITFS Analog Television Rx Sites

A similar prediction can be performed for multiple 3G hubs in the same 35 mile radius service area as shown in the Figure 2 below. These hubs are assumed to be operating on the same frequency as the MMDS/ITFS hub. This is a reasonable assumption since the hubs are separated by a relatively large distance. The interference levels become significantly worse, increasing the interference zone to 80-85% of the available service area.